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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/656,001
Filing Date: September 05, 2003
Appellant(s): NARASIMHAN, RAVI

NARASIMHAN, RAVI
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 03/09/2007 appealing from the Office action mailed 10/17/2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

Pub. No. US 2003/0223391	Malaender et al.	12-2003
Patent No. US 6,801,580	Kadous	10-2004

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 2, 4-8, 10, 13, 15-19, 21, 24, 26-30, 32, 35, 37-41, 43, 46, 48-52, 54 and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Malaender (US-2003/0223391) in view of Kadous (US-6,801,580).

Regarding claims 4, Malaender teaches a method comprising:

selecting a subset of active antennas from a plurality of available antennas in an multi-element antenna system based on higher-order statistics of a propagation medium ([0043]-[0051]; described as "channel coefficient matrix"). But, Malaender fails to expressly teach selecting a constellation for transmission on the active antennas where

said selecting the constellation for transmission on the active antennas comprises selecting different constellations two or more of the active antennas. However, Kadous teaches a similar method of "patial receiver processing techniques include a channel correlation matrix inversion (CCMI) technique (which is also referred to as a zero-forcing technique) and a minimum mean square error (MMSE) technique" (see col. 20, lines 29-37); thus, making it analogous art since it is in the same field of endeavor. Kadous further teaches selecting a constellation for transmission on the active antennas (col. 17, lines 40-59; for more details see fig. 5, cols. 16-18) where said selecting the constellation for transmission on the active antennas comprises selecting different constellations two or more of the active antennas (col. 14, lines 6-10, for more details see fig. 4 and cols. 14-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath channels such that improved performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claims 7, Malaender teaches a method comprising:

selecting a subset of active antennas from a plurality of available antennas in an multi-element antenna system based on higher-order statistics of a propagation medium ([0043]-[0051]; described as "channel coefficient matrix"). But, Malaender fails to expressly teach where said selecting comprises selecting an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin. Kadous further teaches

where said selecting comprises selecting an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin (col. 16, lines 15-33; for more details see cols. 11-16). Therefore, it would have been obvious to one of ordinary skill in the art at the time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath channels such that improved performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claims 15, Malaender teaches an apparatus (fig. 1B) comprising:

a processor (fig. 1B, 140) operative to select a subset of active antennas from a plurality of available antennas in an multi-element antenna system based on higher-order statistics of a propagation medium ([0043]-[0051]; described as "channel coefficient matrix"). But, Malaender fails to expressly teach wherein the processor is operative to select a constellation for transmission on the active antennas and select different constellations two or more of the active antennas. Kadous further teaches wherein the processor (col. 21, lines 3-11) is operative to select a constellation for transmission on the active antennas (col. 17, lines 40-59; for more details see fig. 5, cols. 16-18) and select different constellations two or more of the active antennas. (col. 14, lines 6-10, for more details see fig. 4 and cols. 14-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath channels such that improved

performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claims 18, Malaender teaches an apparatus (fig. 1B) comprising:

a processor (fig. 1B, 140) operative to select a subset of active antennas from a plurality of available antennas in an multi-element antenna system based on higher-order statistics of a propagation medium ([0043]-[0051]; described as "channel coefficient matrix"). But, Malaender fails to expressly teach where the processor is operative to select a constellation for transmission on the active antennas and select an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin. Kadous further teaches where the processor (col. 21, lines 3-11) is operative to select a constellation for transmission on the active antennas and select an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin (col. 16, lines 15-33; for more details see cols. 11-16). Therefore, it would have been obvious to one of ordinary skill in the art at the time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath channels such that improved performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claims 26, Malaender teaches an apparatus (fig. 1B) comprising:

a processor (fig. 1B, 140) including means for selecting a subset of active antennas from a plurality of available antennas in an multi-element antenna system

based on higher-order statistics of a propagation medium. But, Malaender fails to expressly teach means for selecting a constellation for transmission on the active antennas including means for selecting different constellations two or more of the active antennas. Kadous further teaches means for selecting a constellation for transmission on the active antennas (col. 17, lines 40-59; for more details see fig. 5, cols. 16-18) including means for selecting different constellations two or more of the active antennas (col. 14, lines 6-10, for more details see fig. 4 and cols. 14-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath channels such that improved performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claims 29, Malaender teaches an apparatus (fig. 1B) comprising:

a processor (fig. 1B, 140) including means for selecting a subset of active antennas from a plurality of available antennas in an multi-element antenna system based on higher-order statistics of a propagation medium. But, Malaender fails to expressly teach where said selecting comprises selecting an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin. Kadous further teaches where said selecting comprises selecting an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin (col. 16, lines 15-33; for more details see cols. 11-18). Therefore, it would have been obvious to one of ordinary skill in the art at the

time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath channels such that improved performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claims 37, Malaender teaches a system (fig. 1) comprising:

a propagation medium (fig. 1A, 130);

a first transceiver including a plurality of available antennas (fig. 1A; antennas 111a-m);

a second transceiver including a plurality of available antennas (fig. 1A; antennas 121a-n);

a processor (fig. 1B, 140) operative to determine higher-order statistics of a propagation medium from signals received from the plurality of available antennas at the first transceiver ([0046]-[0047]); and antennas selection module operative to select a subset of active antennas from a plurality of available antennas in an multi-element antenna system based on higher-order statistics of a propagation medium ([0046]-[0047]).But, Malaender fails to expressly teach where the processor is operative to select a constellation for transmission on the active antennas and select different constellations two or more of the active antennas. Kadous further teaches where the processor (col. 21, lines 3-12) is operative to select a constellation for transmission on the active antennas (col. 17, lines 40-59; for more details see fig. 5, cols. 16-18) and select different constellations two or more of the active antennas (col. 14, lines 6-10, for

more details see fig. 4 and cols. 14-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath channels such that improved performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claims 40, Malaender teaches a system (fig. 1) comprising:

a propagation medium (fig. 1A, 130);

a first transceiver including a plurality of available antennas (fig. 1A; antennas 111a-m);

a second transceiver including a plurality of available antennas (fig. 1A; antennas 121a-n);

a processor (fig. 1B, 140) operative to determine higher-order statistics of a propagation medium from signals received from the plurality of available antennas at the first transceiver ([0046]-[0047]); and

antennas selection module operative to select a subset of active antennas from a plurality of available antennas in an multi-element antenna system based on higher-order statistics of a propagation medium ([0046]-[0047]). But, Malaender fails to expressly teach where the processor is operative to select an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin. Kadous further teaches where the processor (col. 21, lines 3-12) is operative to select an optimum number of

antennas to maximize a minimum signal-to-noise (SNR) margin (col. 16, lines 15-33; for more details see cols. 11-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath channels such that improved performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claims 48, Malaender teaches a computer program [0054] comprising the steps of:

selecting a subset of active antennas from a plurality of available antennas in an multi-element antenna system based on higher-order statistics of a propagation medium ([0043]-[0051]; described as "channel coefficient matrix"). But, Malaender fails to expressly teach selecting a constellation for transmission on the active antennas where said selecting the constellation for transmission on the active antennas comprises selecting different constellations two or more of the active antennas. Kadous further teaches selecting a constellation for transmission on the active antennas where said selecting the constellation for transmission on the active antennas (col. 17, lines 40-59; for more details see fig. 5, cols. 16-18) comprises selecting different constellations two or more of the active antennas (col. 14, lines 6-10, for more details see fig. 4 and cols. 14-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath

channels such that improved performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claims 51, Malaender teaches a computer program [0054] comprising the steps of:

selecting a subset of active antennas from a plurality of available antennas in an multi-element antenna system based on higher-order statistics of a propagation medium ([0043]-[0051]; described as "channel coefficient matrix"). But, Malaender fails to expressly teach where said selecting comprises selecting an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margi. Kadous further teaches where said selecting comprises selecting an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin (col. 16, lines 15-33; for more details see cols. 11-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time the appellant's invention as taught by Kadous in the method of Malaender in order to "process a number of received symbol streams in a MIMO system with multipath channels such that improved performance may be achieved when using successive interference cancellation (SIC) receiver processing" (see SUMMARY).

Regarding claim 2, 13, 24, 35, 57 and 46, Malaender and Kadous disclose all the limitations of claims 4, 15, 26, 37, 40 and 48 respectively. Malaender further teaches wherein the higher-order statistics comprise second-order statistics of the propagation medium ([0046]-[0047]).

Regarding claim 5, 16, 27, 38 and 49, Malaender and Kadous disclose all the limitations of claims 4, 15, 26, 37 and 48 respectively. Kadous further teaches wherein the multi-element antenna system comprises a multiple-in multiple-out (MIMO) system (see abstract).

Regarding claim 6, 17, 28, 39 and 50, Malaender and Kadous disclose all the limitations of claims 4, 15, 26, 37 and 48 respectively. Malaender further teaches wherein said selecting comprises selecting the subset of active antennas based on correlation matrices among the active antennas ([0046]-[0047]).

Regarding claim 8, 19, 30, 41 and 52, Malaender and Kadous disclose all the limitations of claims 4, 15, 26, 37 and 48 respectively. Malaender further teaches wherein said selecting comprises selecting the subset of active antennas based on a fixed data rate [0018].

Regarding claim 10, 21, 32, 43 and 54, Malaender and Kadous disclose all the limitations of claims 4, 15, 26, 37 and 48 respectively. Kadous further teaches allocating substantially equal power to each of said active antennas (col. 15, lines 63-67).

Reasons for Allowance

2. Claims 9, 11, 20, 22, 31, 33, 42, 44, 53, 55, 58 and 59 are allowed.

The following is a statement of reason for the indication of allowance:

Claims 9, 11, 20, 22, 31, 33, 42, 44, 53, 55, 58 and 59 are allowed with the same reasons set forth in the Office Action mailed 05/01/2006 (page 13).

(10) Response to Argument

Appellant's arguments have been fully considered and are deemed not persuasive for following reasons.

Claim 4 and its dependent claims

Appellant argued that "Kadous does not teach or suggest varying the number of antennas or the constellations selected for the antennas in a transmission system" and "Kadous is silent as to selecting different constellations for two or more of the active antennas (i.e., at least two different constellations for two antennas)". The examiner respectfully disagrees with the appellant's argument. Kadous shows in figure 5 (see fig. 5 and its description) a transmission system with a various number of transmitted antennas (124a-124t) and each of transmitted antennas transmits each of data streams with specific data rate selection, separate coding and modulation scheme ("per antenna basis"; see col. 17). Kadous also describes that the coded data for each data stream is modulated based on one or more constellation selection (e.g., BPSK, QSPK, M-PSK, or M-QAM) to provide the specific modulation symbol (see fig. 1 and col. 4, lines 31-67) and each specific modulation symbol is selected for each transmit antenna (col. 18, lines 15-17). Since the different selected constellations provide the different modulation symbols (see fig. 5 and col. 17, line 12--col. 18, line 45); therefore Kadous discloses the

claimed limitation of "selecting a constellation for transmission on the active antennas where said selecting the constellation for transmission on the active antennas comprises selecting different constellations two or more of the active antennas".

It is believed that Malaender and Kadous disclose all the limitations of the independent claim 4. Thus, the combination of Malaender and Kadous can be used to establish prima facie obviousness for its dependent claims because the references teach or suggest all claim limitations as required. See MPEP § 2143.03. Therefore, prima facie obviousness under 35 U.S.C. § 103 has been established.

Claim 7

Appellant argued that Kadous does not disclose "selecting comprises selecting an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin". The examiner respectfully disagrees with the appellant's argument. Kadous shows in figure 5 (see fig. 5 and its description) a transmission system with a various number of transmitted antennas (124a-124t) and each of transmitted antennas transmits each of data streams with specific data rate selection, separate coding and modulation scheme ("per antenna basis"; see col. 17). Kadous describes that each specific symbol stream is transmitted on selected antenna (see fig. 5 and col. 17, line 12--col. 18, line 45). Kadous also suggests that the symbol stream with the highest margin should be selected (col. 16). Since each symbol stream is determined based on SNR (for details see cols. 11-18); therefore Kadous discloses the claimed limitation of "selecting comprises selecting an optimum number of antennas to maximize a minimum signal-to-noise (SNR) margin".

Claim 15 and its dependent claims

Appellant argued that the proposed combination of Malaender and Kadous fails to teach or suggest all the limitations of claim 15 and its dependent claims for at least reasons similar to claim 4. The examiner contends that Malaender and Kadous disclose all the limitations of the claim 15 and its dependent claims for the same reasons being applied to claim 15 and its dependent claims as they are to the above mentioned claim 4.

Claim 18

Appellant argued that the proposed combination of Malaender and Kadous fails to teach or suggest all the limitations of claim 18 for at least reasons similar to claim 7. The examiner contends that Malaender and Kadous disclose all the limitations of the claim 18 the same reasons being applied to claim 18 as they are to the above mentioned claim 7.

Claim 26 and its dependent claims

Appellant argued that the proposed combination of Malaender and Kadous fails to teach or suggest all the limitations of claim 26 and its dependent claims for at least reasons similar to claim 4. The examiner contends that Malaender and Kadous disclose all the limitations of the claim 26 and its dependent claims for the same reasons being applied to claim 26 and its dependent claims as they are to the above mentioned claim 4.

Claim 29

Appellant argued that the proposed combination of Malaender and Kadous fails to teach or suggest all the limitations of claim 29 for at least reasons similar to claim 7. The examiner contends that Malaender and Kadous disclose all the limitations of the claim 29 the same reasons being applied to claim 29 as they are to the above mentioned claim 7.

Claim 37 and its dependent claims

Appellant argued that the proposed combination of Malaender and Kadous fails to teach or suggest all the limitations of claim 37 and its dependent claims for at least reasons similar to claim 4. The examiner contends that Malaender and Kadous disclose all the limitations of the claim 37 and its dependent claims for the same reasons being applied to claim 37 and its dependent claims as they are to the above mentioned claim 4.

Claim 40 and its dependent claims

Appellant argued that the proposed combination of Malaender and Kadous fails to teach or suggest all the limitations of claim 40 and its dependent claims for at least reasons similar to claim 4. The examiner contends that Malaender and Kadous disclose all the limitations of the claim 40 and its dependent claims for the same reasons being applied to claim 40 and its dependent claims as they are to the above mentioned claim 4.

Claim 48 and its dependent claims

Appellant argued that the proposed combination of Malaender and Kadous fails to teach or suggest all the limitations of claim 48 and its dependent claims for at least reasons similar to claim 4. The examiner contends that Malaender and Kadous disclose all the limitations of the claim 48 and its dependent claims for the same reasons being applied to claim 48 and its dependent claims as they are to the above mentioned claim 4.

Claim 51

Appellant argued that the proposed combination of Malaender and Kadous fails to teach or suggest all the limitations of claim 51 for at least reasons similar to claim 7. The examiner contends that Malaender and Kadous disclose all the limitations of the claim 51 the same reasons being applied to claim 51 as they are to the above mentioned claim 7.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

(12) Conclusion

For the above reasons, it is believed that the rejection is proper, and the Board of Patent Appeals and Interferences is therefore respectfully urged to sustain the Examiner's rejection.

Respectfully submitted,

Huyphan

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